ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

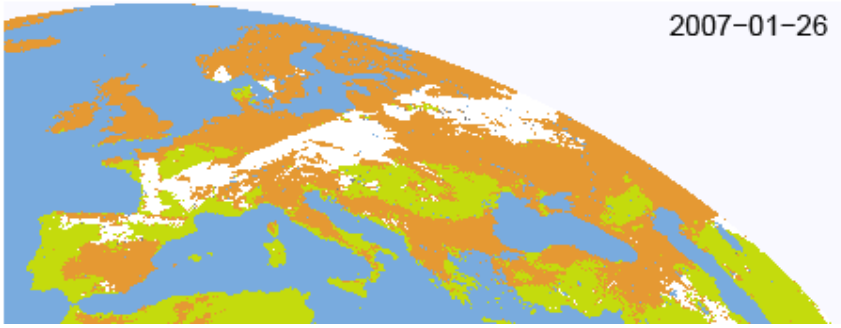
Snow, albedo and SNORTEX

Terhikki Manninen

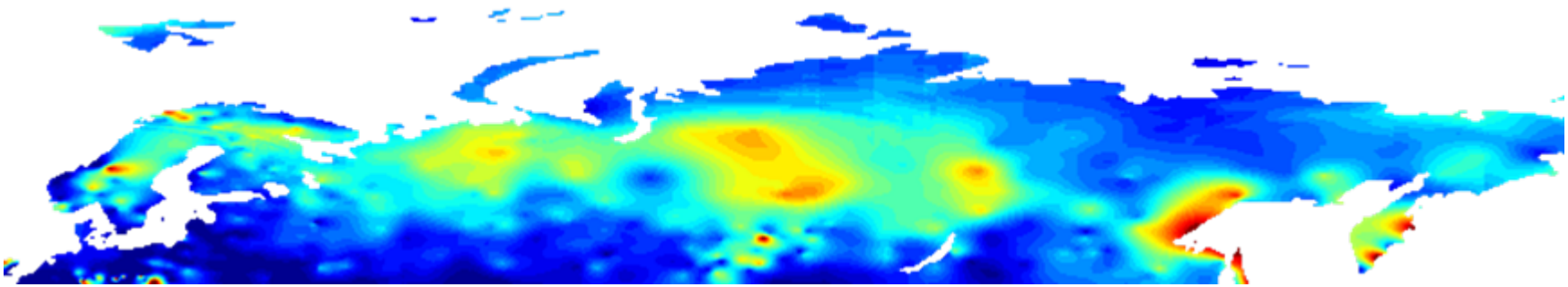
UHA/MAP

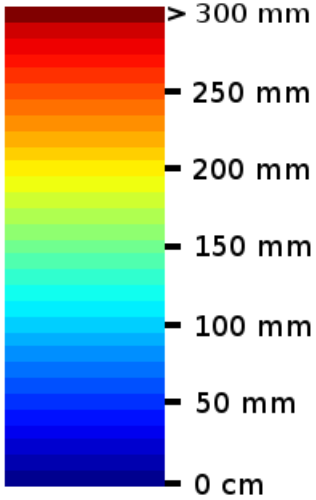
Snow product being developed at FMI

- **Daily snow product of Land-SAF**
  - Currently from MSG/SEVIRI
  - In the future from METOP/AVHRR
  - Not for mountaineous areas



Snow water equivalent on March 24, 2009





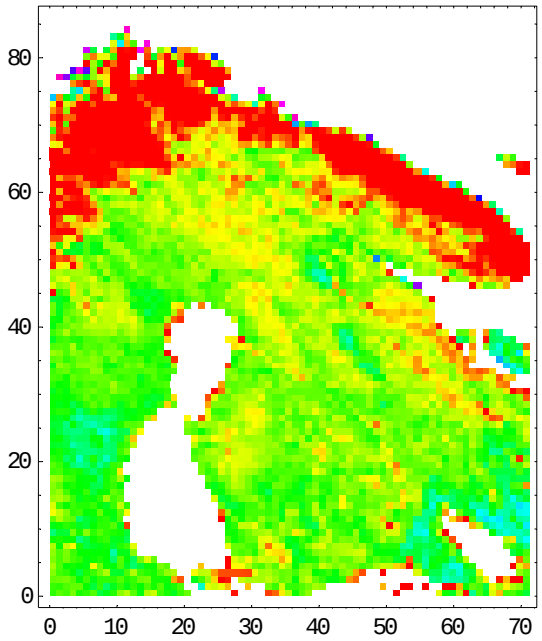
Other H-SAF products of FMI:

- Snow on/off including mountains (with Turkey)

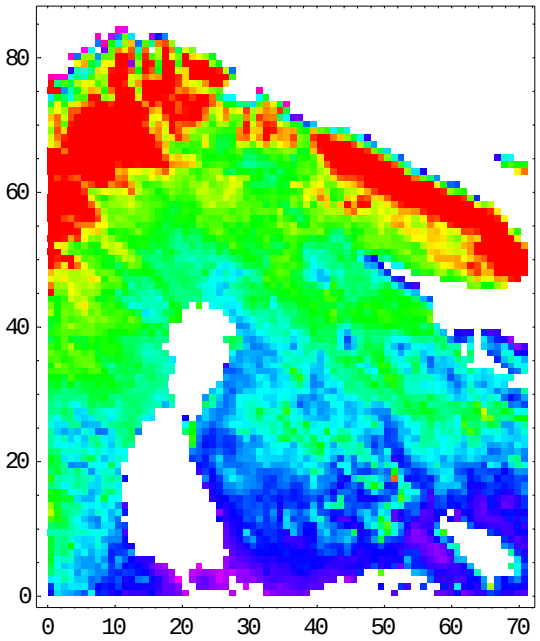
- Fractional snow cover

- Snow status

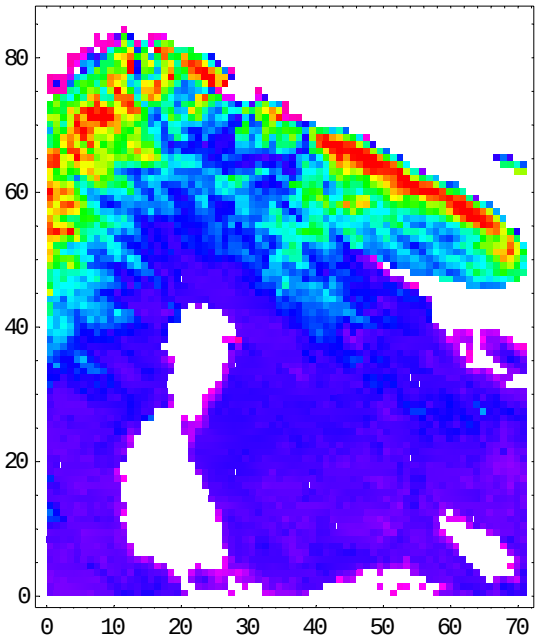
NOAA/AVHRR based surface albedo of Finland



March 2006



April 2006



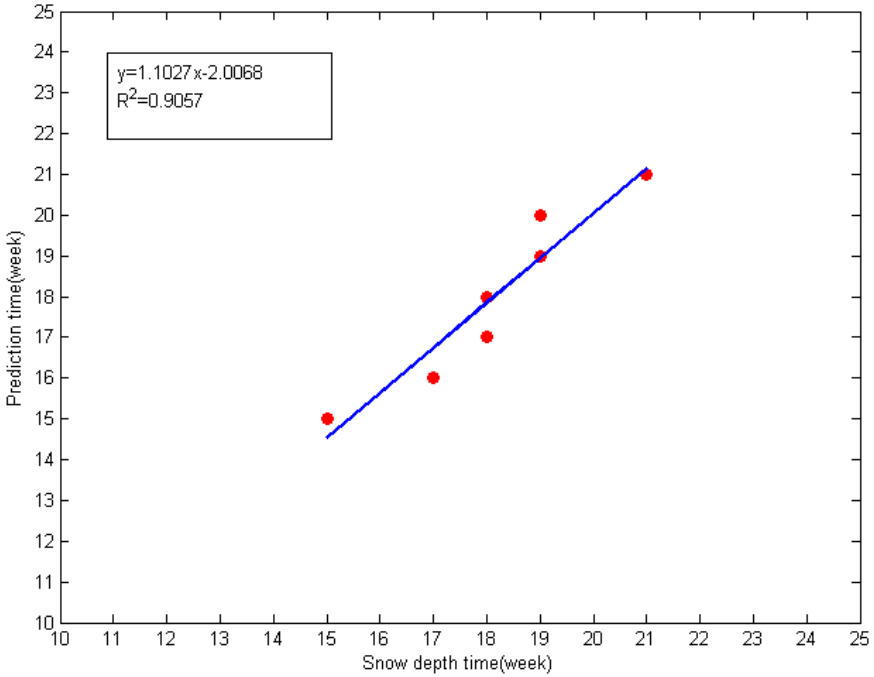
May 2006

AVHRR resolution 1 km

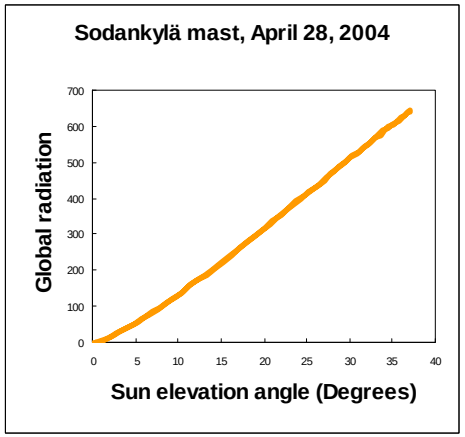
albedo product pixel size 15 km x 15 km

Snow melt detection using CM-SAF weekly surface albedo product

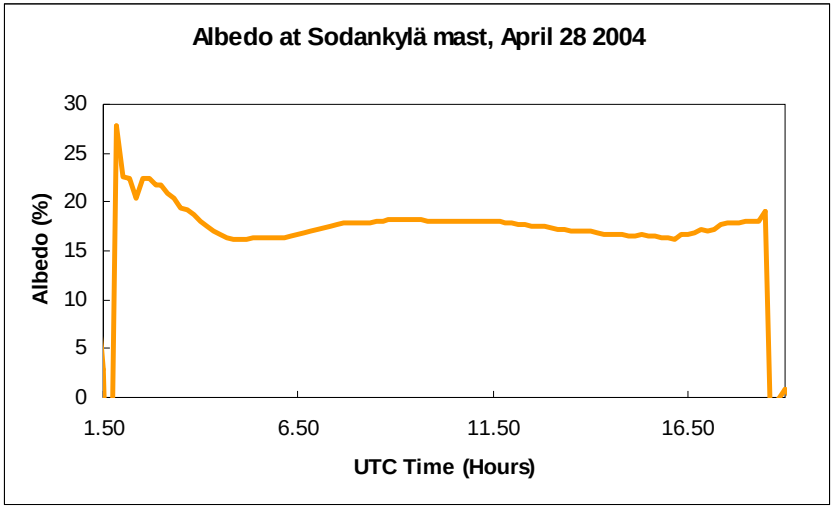
- Change of albedo from winter to summer value indicated snow melt
- Timing of snow melt was derived from the weekly CM-SAF albedo product (SAL)
- Results were compared with ground based albedo and snow depth measurements
- Good correlation was observed



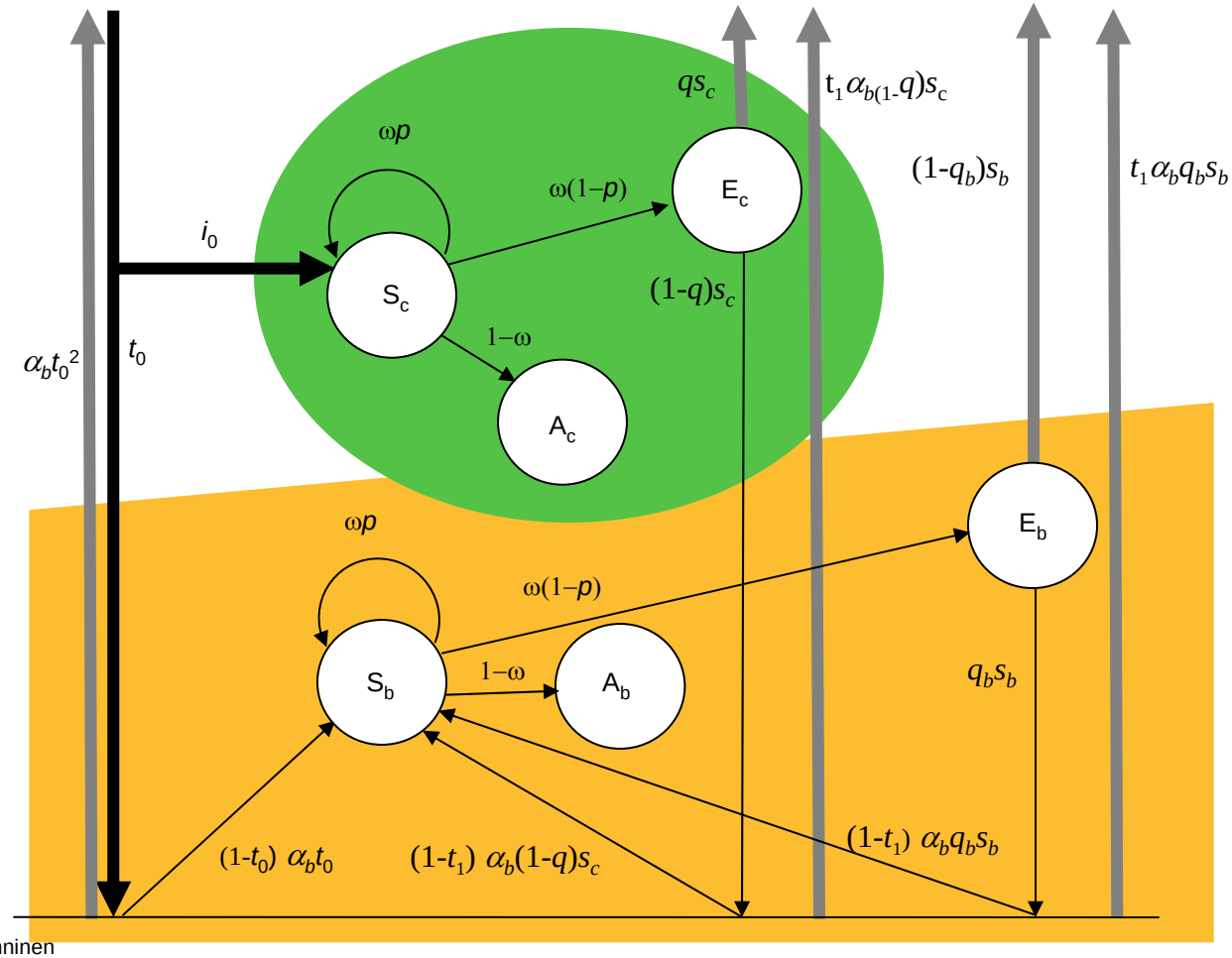
Sodankylä mast albedo, April 28, 2004



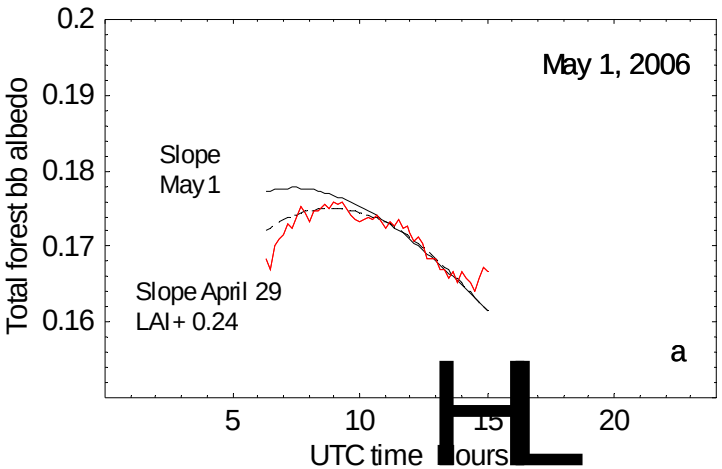
- **Start of snow melting season**
- **Perfectly clear sky on April 28**

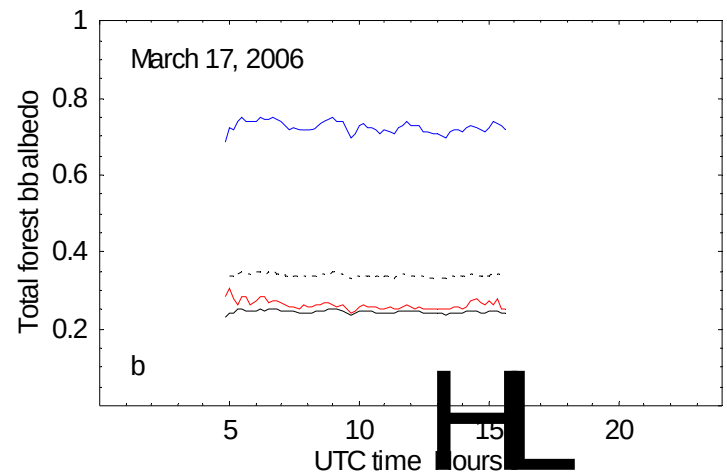


Canopy scattering model including the forest floor effect developed by Manninen and Stenberg



Simulated and measured surface albedo at Tähtelä

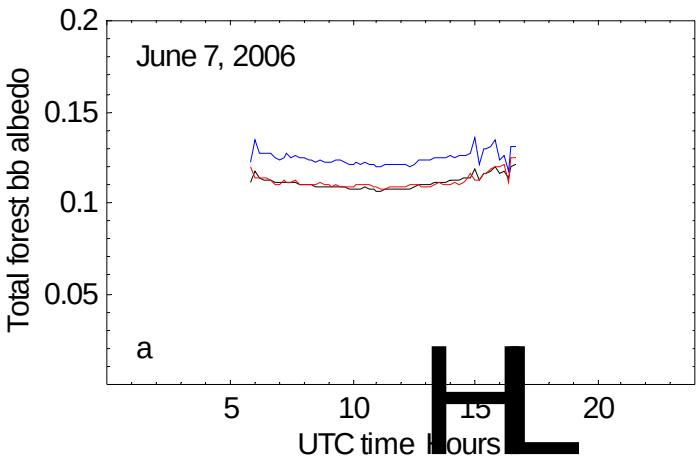




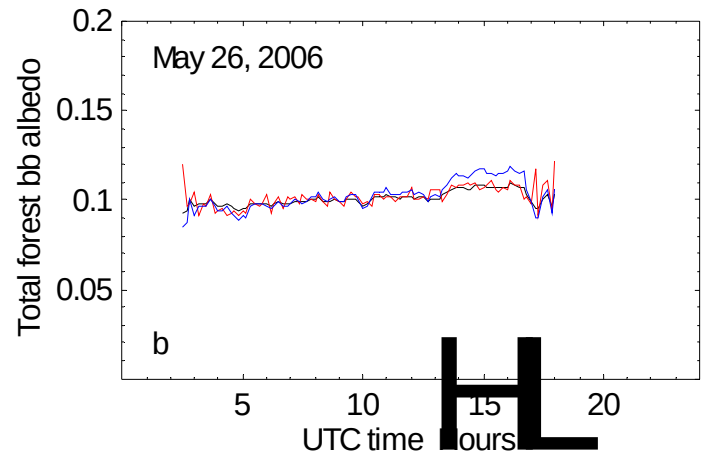
Ground measurement

Mast measurement

Simulation

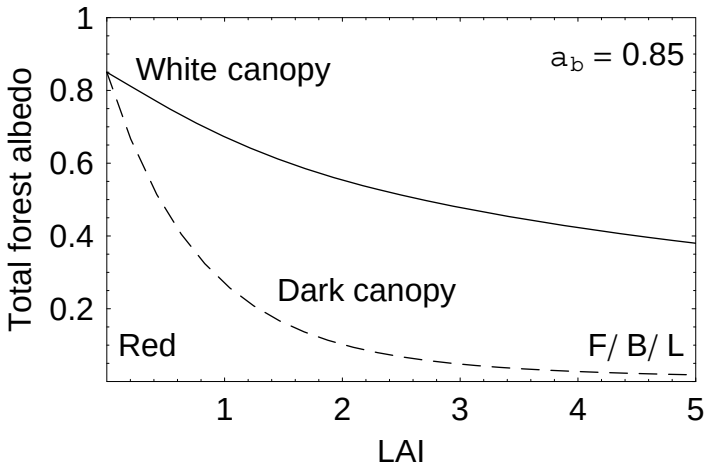


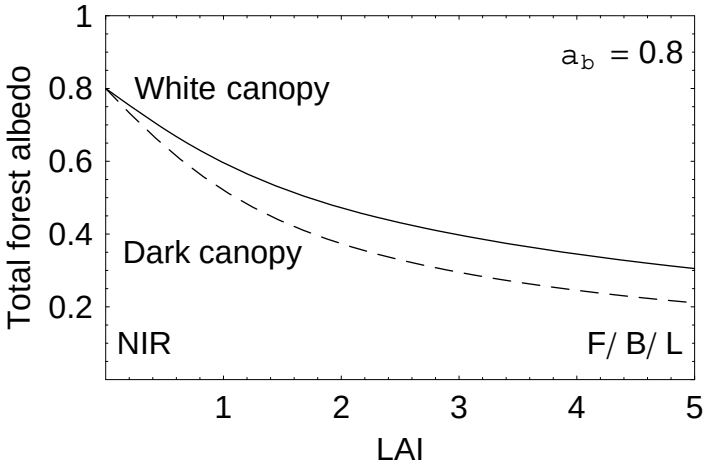
Black sky albedo



White sky albedo

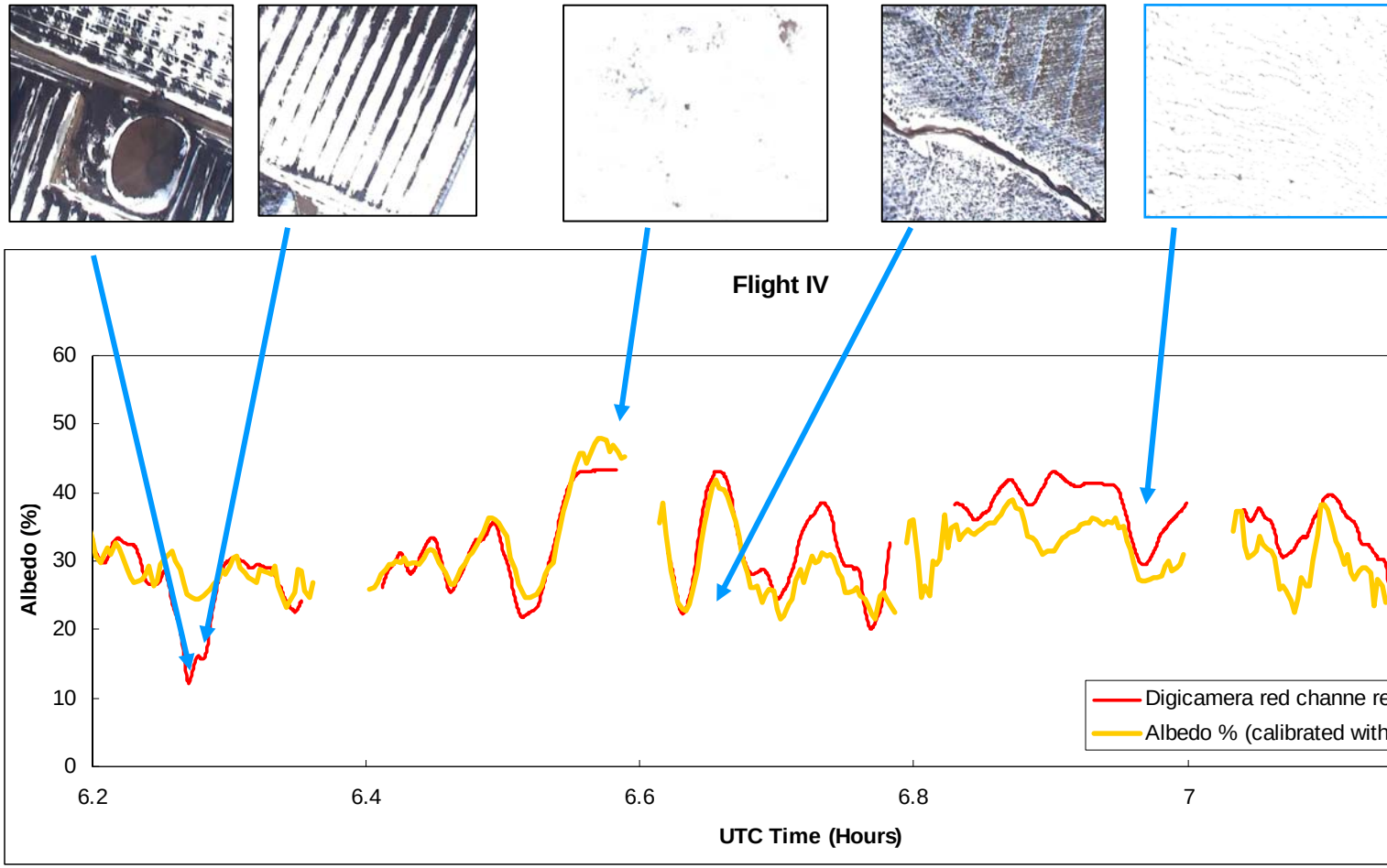
Total forest albedo when the forest floor is snow covered





Canopy scattering model simulation results

Pyranometer measurements vs. digivideo camera



FMI CM-SAF, Land-SAF and Hydro-SAF interest in SNORTEX

- **Surface Albedo and snow product validation**
- **Current forest albedo is based on BRDF designed for summer conditions**

  => imrovement of winter time BRDF
- **Current satellite based forest BRDF is based parametrized using NDVI, which does not characterise boreal forest properly**

  => imrovement of BRDF parametrization
- **At high latitudes sun elevation is often a limiting factor for albedo estimation**

  => microwave BRDF/albedo estimation method development
- **Current snow product only fro MSG/SEVIRI**

  => METOP/AVHRR and microwave based snow estimation method development

Snow measurements

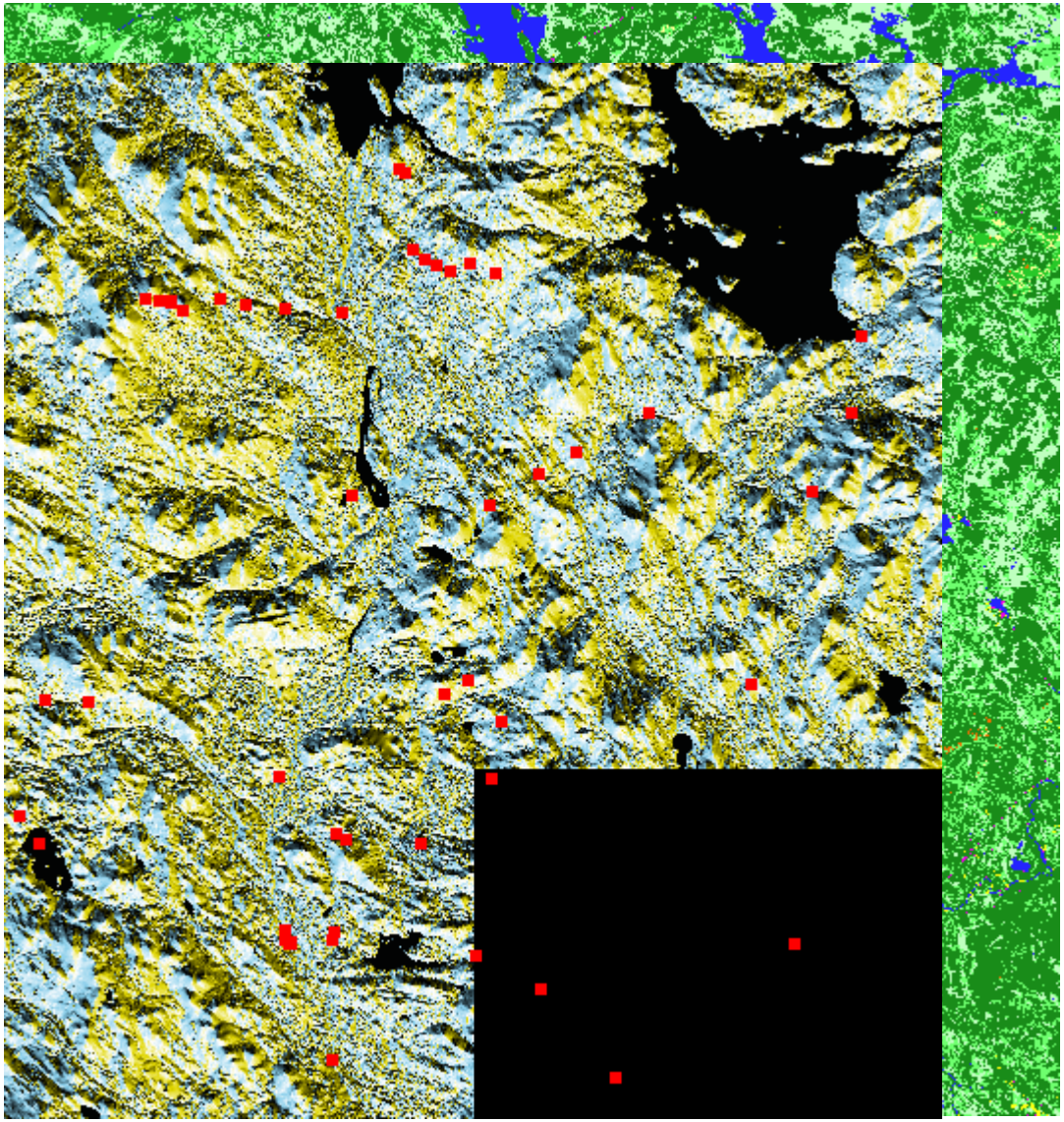
CORINE land cover map,

25 m pixel size

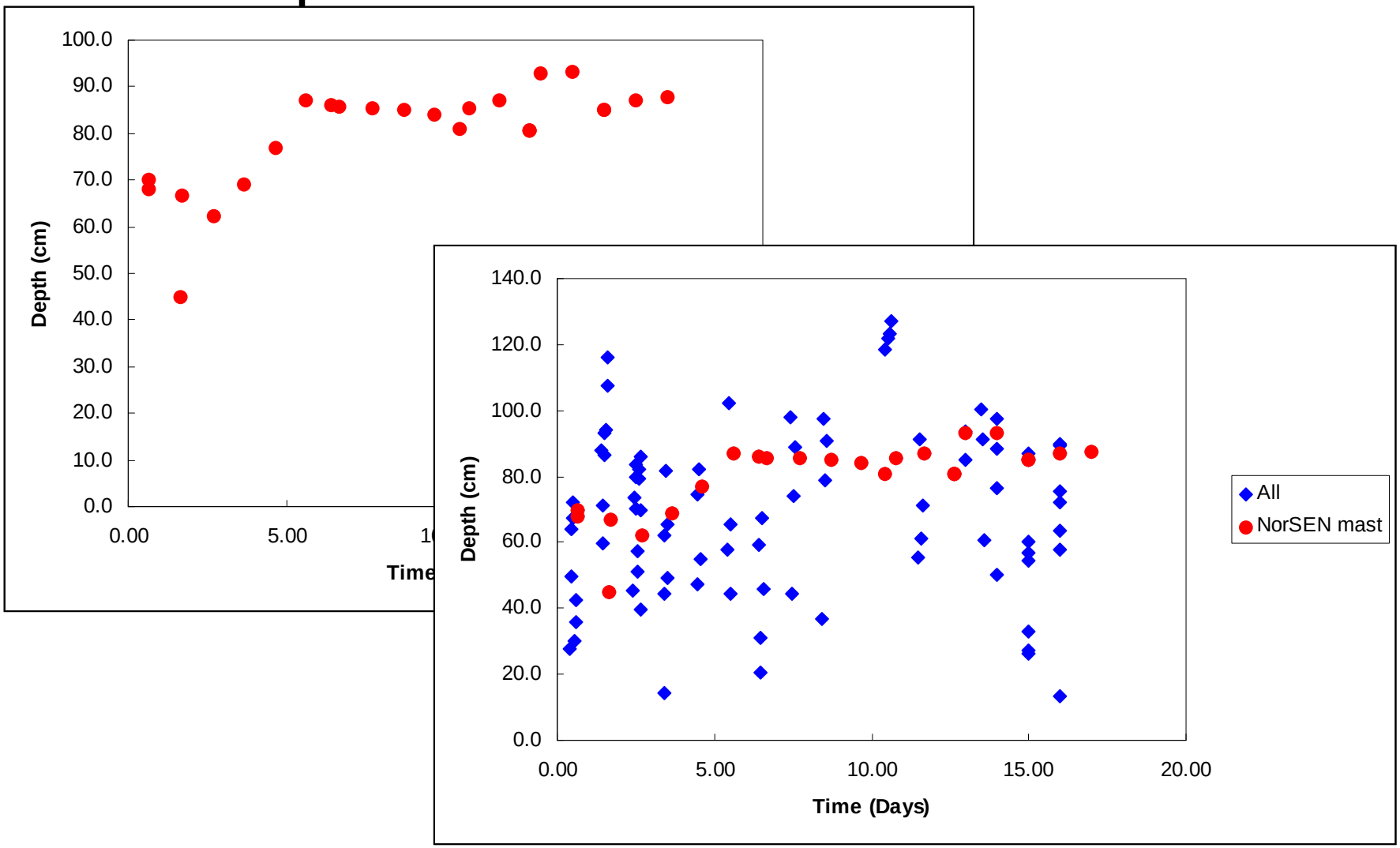
DEM, 10 m pixel size

Slope, 10 m pixel size

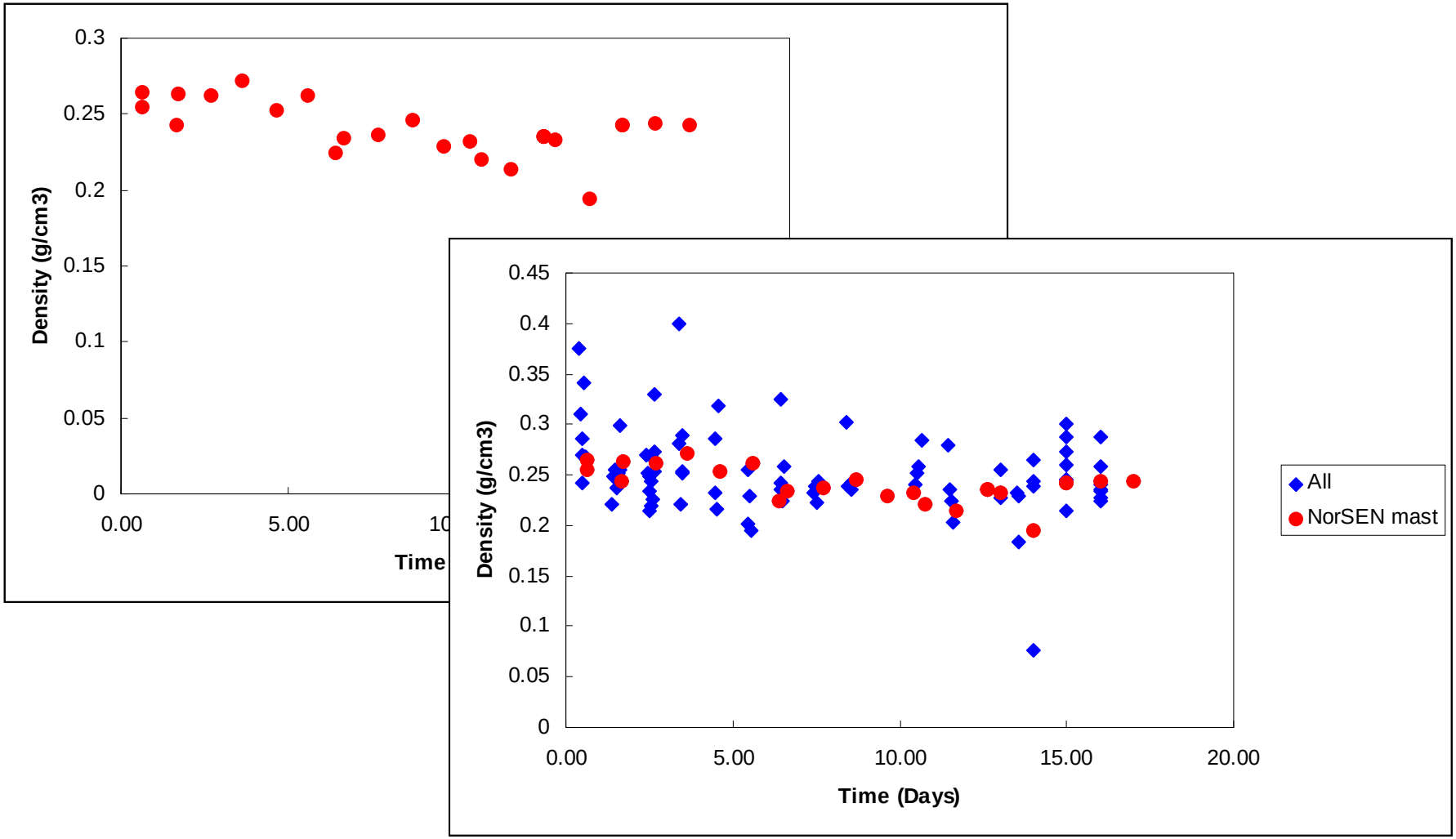
Aspect, 10 m pixel size



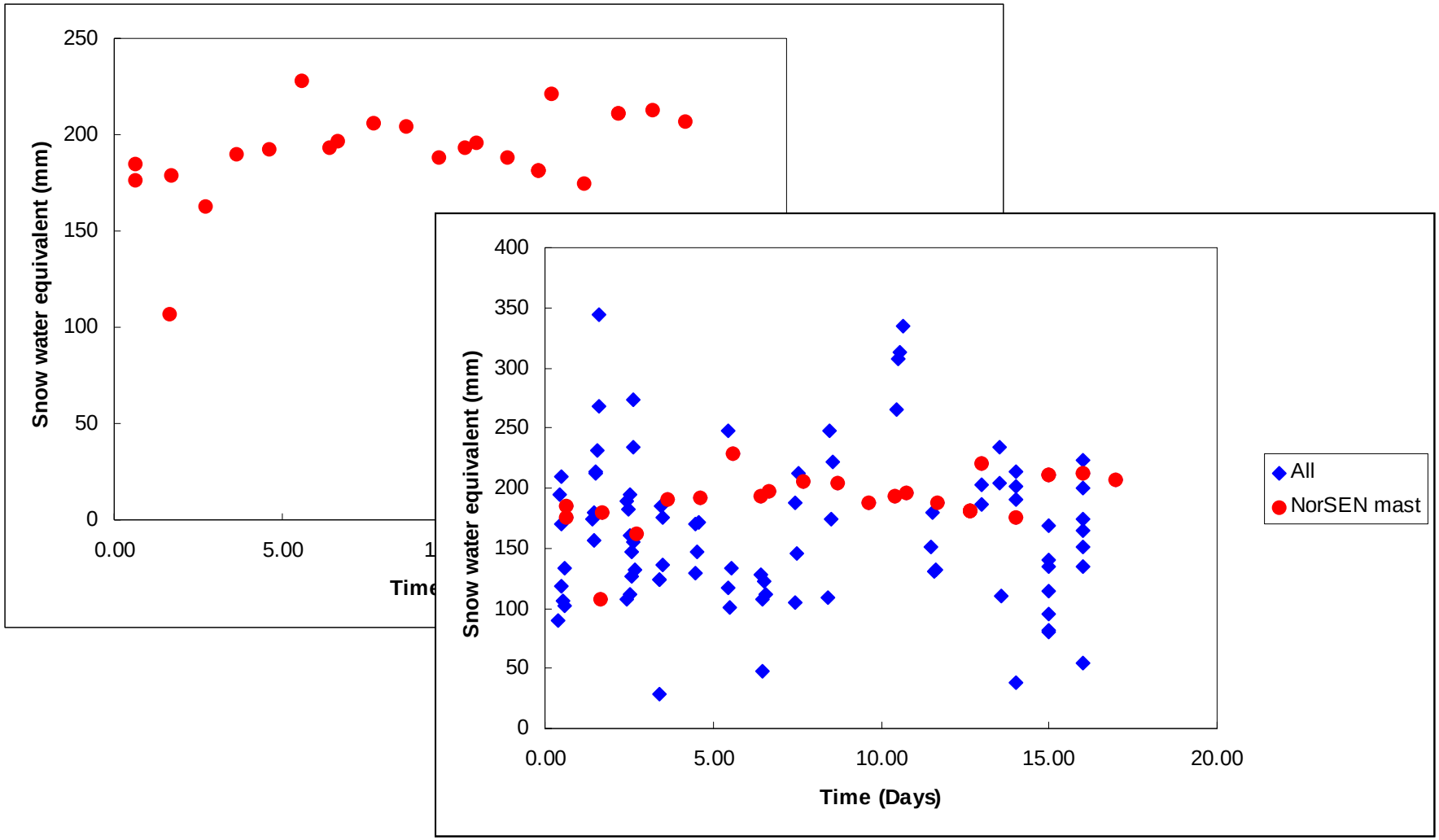
Snow depth


100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Depth (cm)
0.00
5.00
Time
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Depth (cm)
0.00
5.00
10.00
15.00
20.00
Time (Days)
All
NorSEN mast

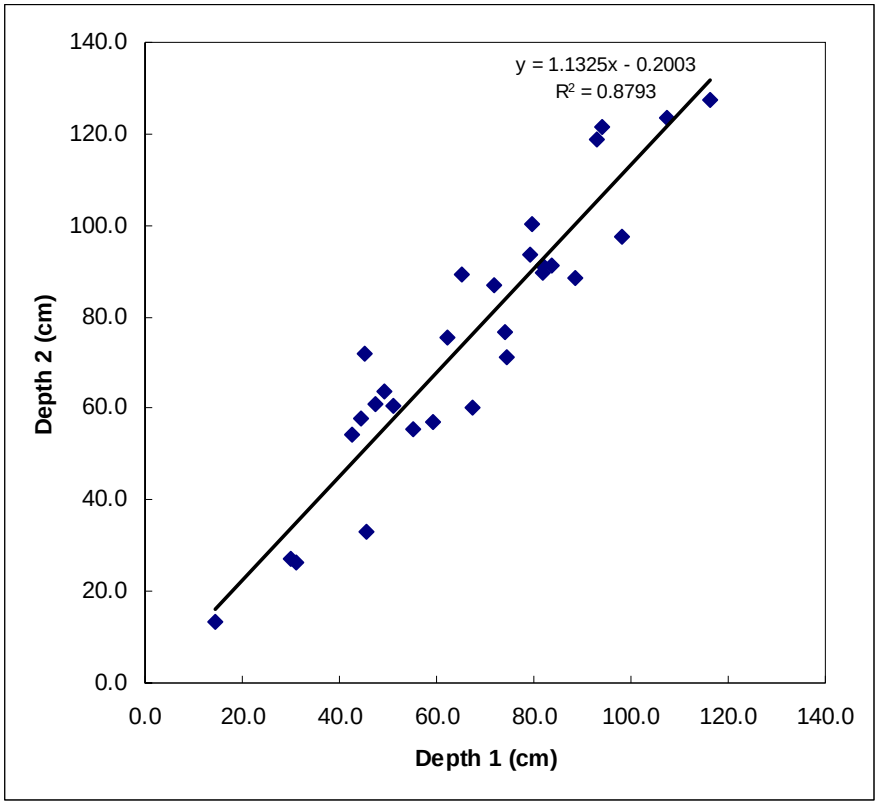
Snow density

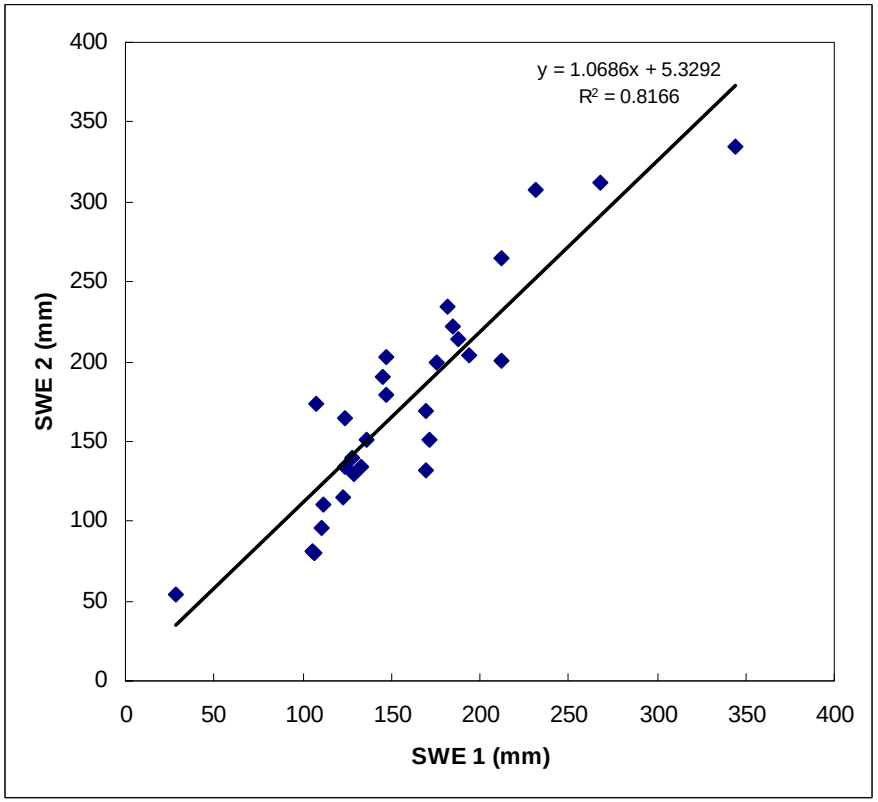


Snow water equivalent

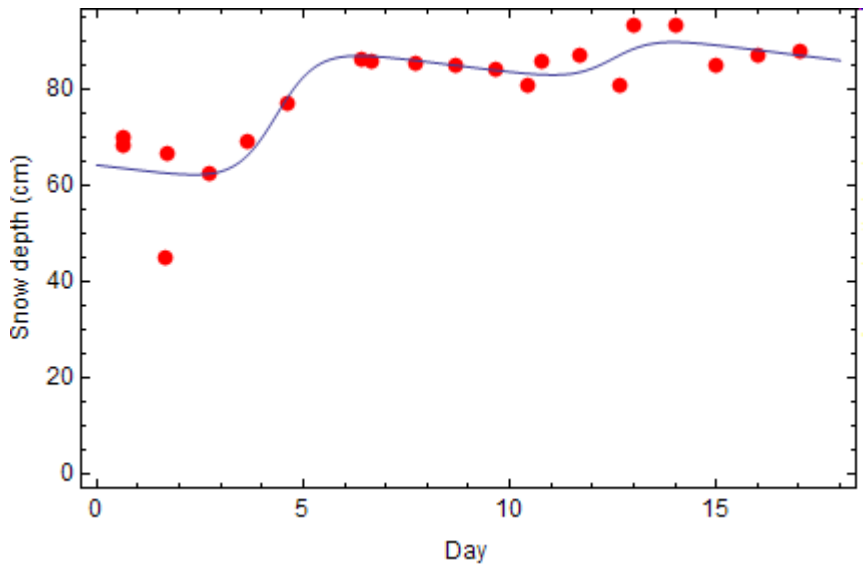


Changes in snow cover depth and SWE





Time dependence of snow depth



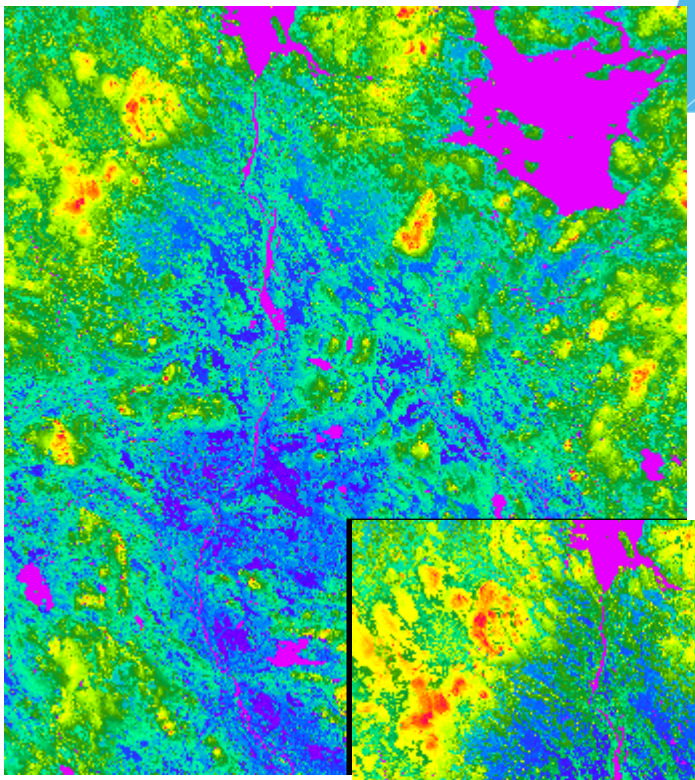
Time series at NorSEN mast

84.7 -1.08 day -15.0* Tanh[4.35 -day]-5.5 Tanh[12.5 -day]

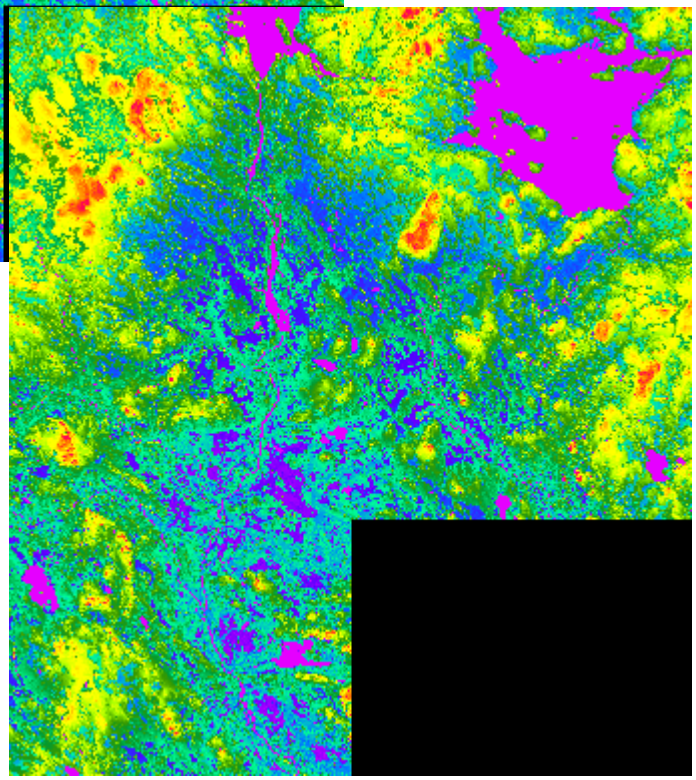
Snow depth during the flights

©Terhikki Manninen, FMI

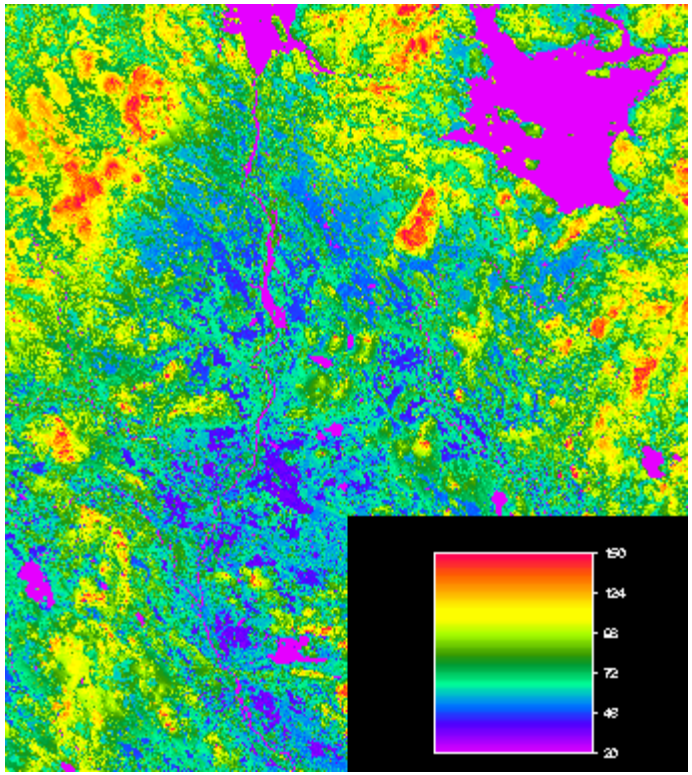
April 3



April 7



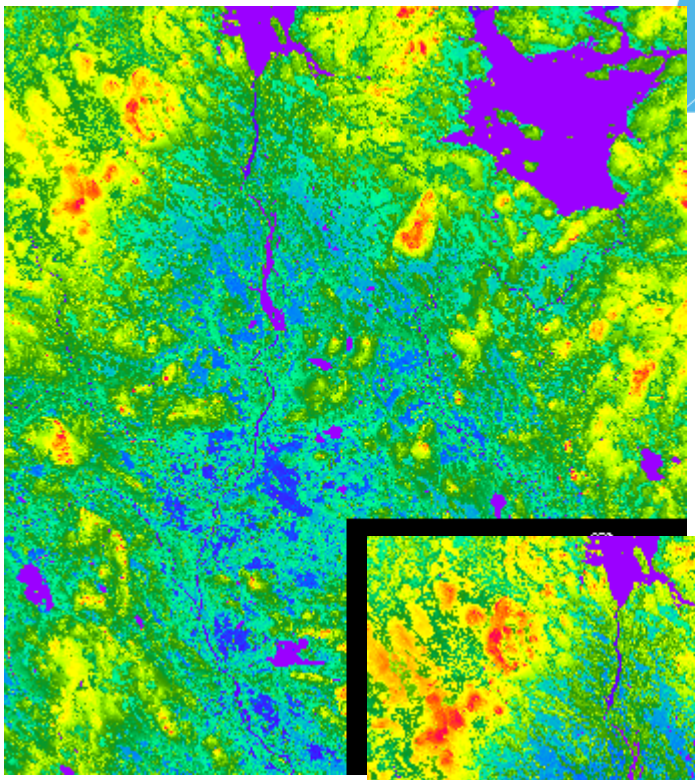
April 10



SWE during the flights

© Terhikki Manninen, FMI

April 3



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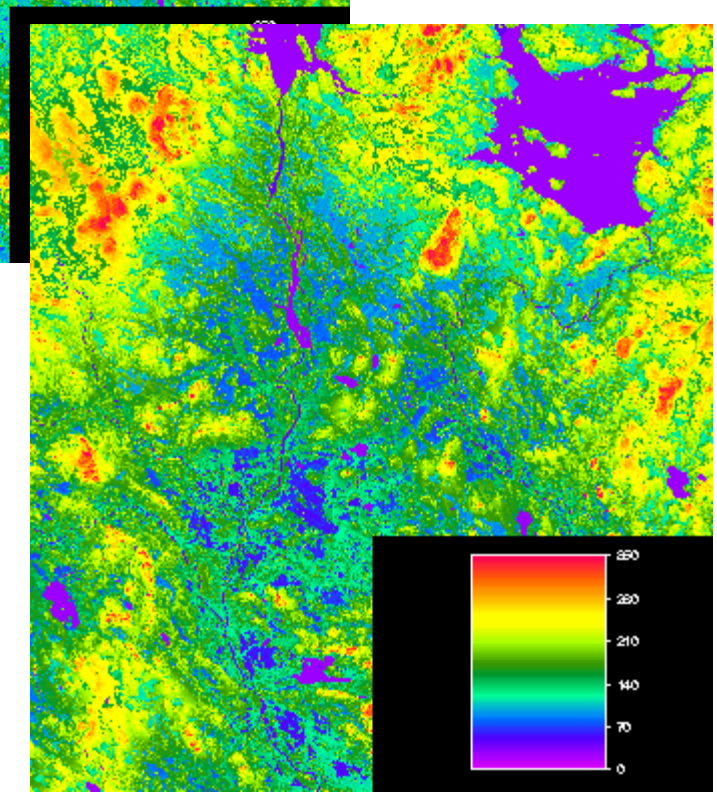

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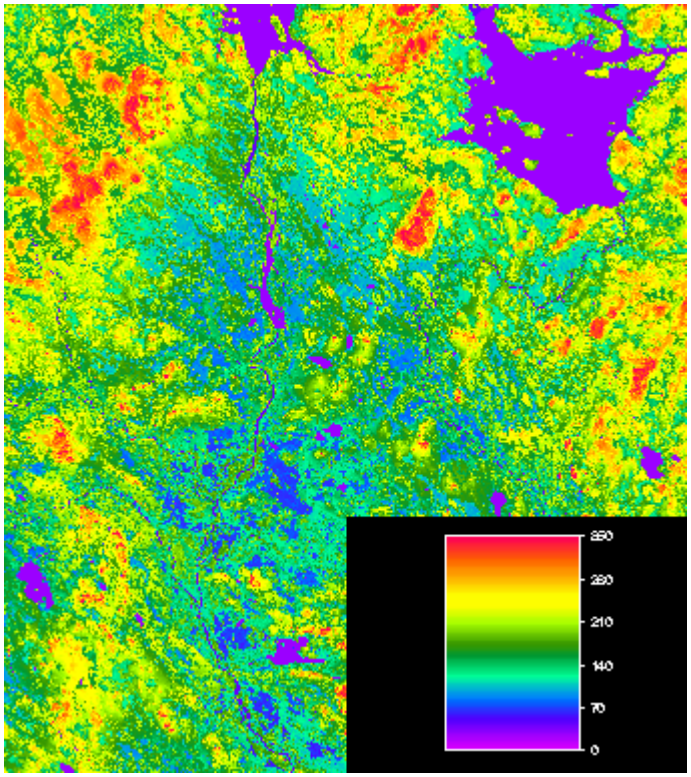
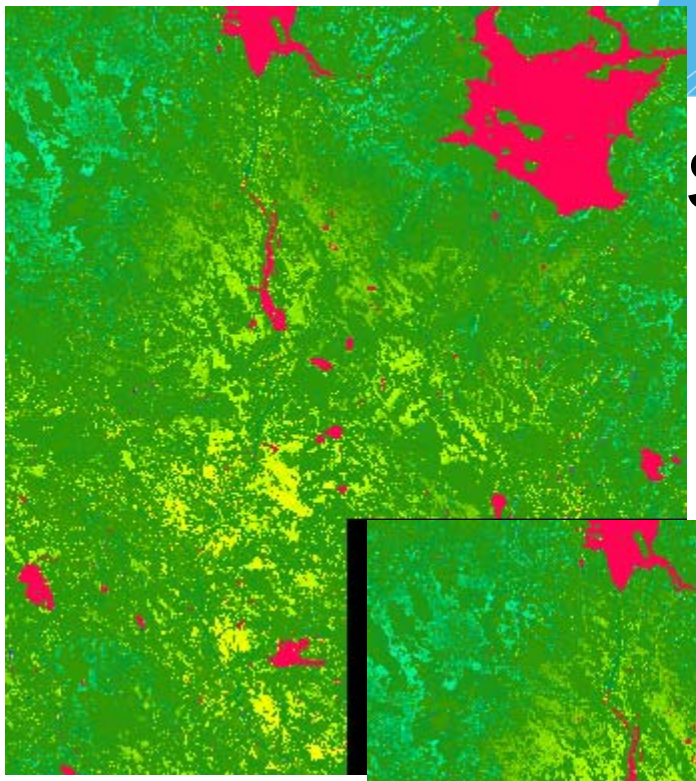


Snow density during the flights

© Terhikki Manninen, FMI

April 3



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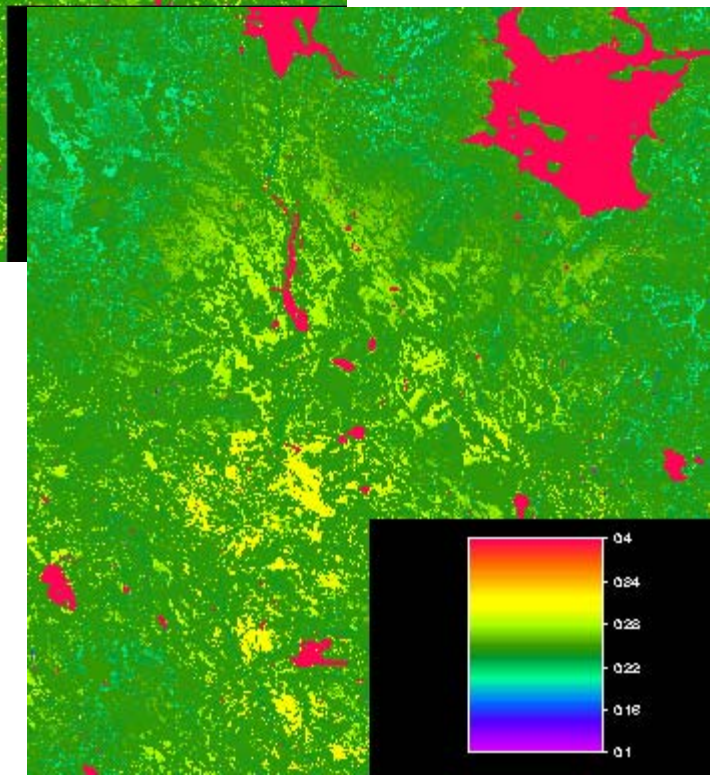
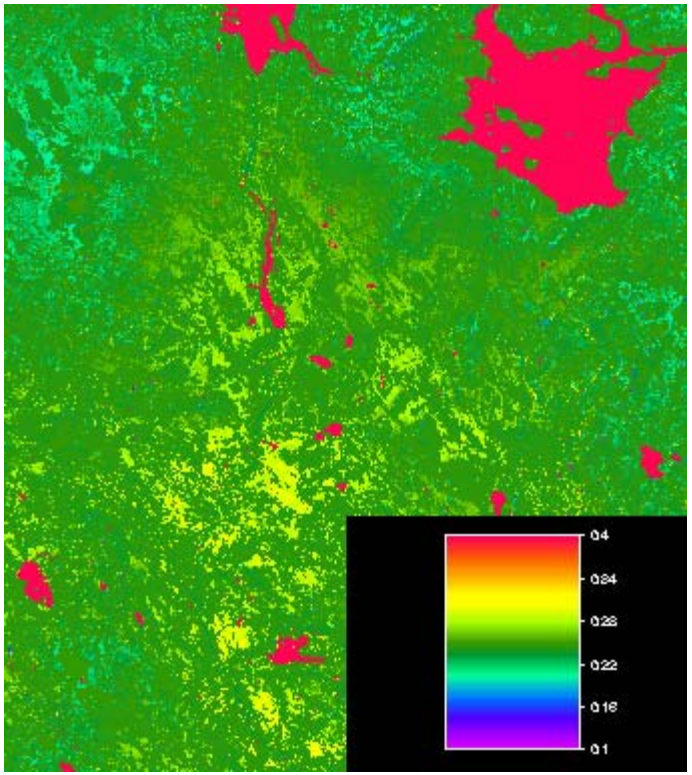
April 10